ROYAL GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 57.] SEPTEMBER. [1891.

CCXII.—ORANGE SCALE IN CYPRUS.

(*Aspidiotus aurantii.*)

Orange trees in certain localities are peculiarly liable to be attacked by scale insects. The result, in many cases, is a serious loss to cultivators. Scale insects have been noticed to be more prevalent on orange trees in a dry climate than in a moist one. The particular insect now under notice (*Aspidiotus aurantii*) is widely distributed throughout tropical and sub-tropical regions, and the remedial measures which are recommended for its treatment cannot be too widely known. Mr. Arthur E. Shipley, F.L.S., who has undertaken the present inquiry, is Demonstrator of Comparative Anatomy at the University of Cambridge, and possesses special qualifications for work of this kind. It will be noticed that Mr. Shipley is desirous of receiving specimens of coccidæ which infest plants, as also of the nematode worms parasitic on plants with portions of their respective hosts.

LONDON:
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1891.

Price Twopence.

Mr. Arthur E. Shipley, F.L.S., to Royal Gardens, Kew.

Christ's College, Cambridge,
Dear Mr. Thiselton-Dyer, July 16, 1891.

In forwarding you the enclosed report, I should like to take the opportunity of making it known that I am very anxious to obtain (i) examples of coccidæ which infest plants, and (ii) examples of nematode worms parasitic in plants, with the affected parts of their respective hosts.

I should be very grateful to anyone who would send me, at the above address, specimens of these two classes of plant pests.

Yours, &c.
(Signed) Arthur E. Shipley.

W. T. Thiselton-Dyer, Esq., C.M.G., F.R.S.

Report on an Orange Disease in Cyprus, caused by a Scale Insect.

The material which forms the text of the following report was kindly sent me by Captain Arthur Young, Commissioner at Famagusta, who has also been good enough to forward me the details of the spread of the pest throughout Cyprus, which will be found below.

The disease is caused by the presence of a scale insect, *Aspidiotus aurantii*, Maskell, which is a member of the sub. family *Diaspinæ*. This sub-family with some others, compose the family *Coccidæ*, insects popularly known as Scale insects, Bark lice, Mealy bugs, &c. *Aspidiotus aurantii* seems to have been first named *Aspidiotus coccineus* by the Greek entomologist Gennadius, and, since this name has priority, it ought to have been retained. Nevertheless, the American entomologists, to whom we are almost entirely indebted for our knowledge of the methods of dealing with this pest, consistently use Maskell's name, and I have therefore thought it well to do the same. The species has also been called *Aspidiotus citri*, and is popularly known in America as the Red scale of California.

The precise home of this insect has not yet been determined, and it is variously stated to be Europe and Australia. It is one of the most, if not the most, destructive of the insects which attack orange or lemon trees, and is notorious for the damage it has done in California, and, more recently in Florida, in Australia, New Zealand, and other parts of the world. A single instance of the loss this pest occasions may be quoted from Mr. Comstock's report of 1881. The rental of an orange grove of 33 acres had to be reduced from 1,800*l.* to 120*l.* in six years on account of the ravages of this insect.

The disease seems to have been noticed in Cyprus for the last six or eight years. In the district of Limassol the insect was found six years ago in every garden at Episcopi and Kolossi, two orange districts, and it must have been there for some years previously. At Nikosia it has been prevalent for eight years or more, and at Larnaca for at least six years. It was first noticed at Famagusta in 1888, but it was only in 1890 that the gardens were seriously affected. The sweet lemons are the first attacked, then the lemons, and lastly the oranges ; old and young trees are attacked alike. On the whole it seems that the disease is taking firm hold in the island, and prompt measures should be at once taken to arrest its progress before it is too late.

Appearance of the Diseased Trees.

The scale is found on the fruit, leaves, and smaller branches of the affected trees. In the specimens sent to England, both the oranges and lemons were so covered with the insect that at least half the outside of the fruit was concealed by their presence, and there must have been several thousand insects on each orange. Fig. I. attempts to represent the appearance of a piece of orange peel, only very slightly magnified, with the scales scattered over it. An enlarged view of several scales is given in Figs. III., IV., and V. The scale or puparium is really a dirty white, but the body of the insect which underlies it gives the whole a brownish-yellow or dark brown appearance. Some of these, as Fig. I. shows, are much darker than others; they very often overlap one another.

With a lens three different stages of the insect can be detected—(i.) large scales, Figs. IV. and V., which are the mature females after their second moult. The scale which covers them also protects the eggs when they are laid; (ii.) small circular scales (Fig. III*a*.), which cover the female after its first moult. These are formed from the mobile larva (Fig. II.) after it has come to rest and cast its skin. After a second moult these become the large scales, No. i.; (iii.) small oval scales (Fig. III*b*.) which cover the male insect. They are formed in the same way as No. ii.; by the casting of the larval skin. They will ultimately give rise to the winged males (Fig. VI.). A few specks may be seen creeping over the orange peel. These are the mobile larvæ (Fig. IV.) seeking for a resting place.

The Life History of the Insect.

The various stages through which these scale insects pass, in their passage from the egg to the mature form, differ somewhat in the two sexes, so that it will be advisable to consider them separately.

The Female.

We will commence with the female. The eggs which are found massed together under the scale give rise to minute larvæ, which are all but invisible to the naked eye. When magnified, each larva has the form of a slightly oval flattened insect, whose longitudinal axis is but little longer than the transverse (Fig. II.).* This larva is provided with three pair of legs and a pair of antenna, and well developed mouth appendages which collectively form the "rostrum." It now moves actively about over the orange or lemon, or the leaves of these trees, in search of a convenient place to fix itself. This it does by inserting its rostrum into the tissues of its host, and by this means it sucks up the nutritive juices of the plant.

Soon after fixing itself the larva casts its skin, and as a result of this operation, it loses both its legs and antennæ; thus the female fixes itself, and immediately after loses its locomotive organs; hence it becomes fixed for life on the spot where it first took up its position.

The larval skin is not entirely thrown off, but remains covering the insect, and forming the scale, shield, or puparium. In allied species

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* This figure represents the larva of an allied form, *Aspidiotus ficus*. It is copied from Comstock.

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this scale is partly composed of a considerable waxy secretion, which issues from the spinnerets in the form of a cottony, fibrous mass, but the females of *Aspidiotus aurantii* are distinguished from those of allied species by the absence of groups of spinnerets, and although some secretion probably serves to keep the cast skin in its place, this is much less abundant than in other species.

The insect lies thus for some time, covered by its larval skin, and sucking in the plant juices by means of its long proboscis or rostrum. When it is about twice as old as it was at the period of its first casting its skin, it undergoes a second and final moult. The skin thus thrown off is added to the first, and the insect lies as a motionless mass covered in by the two larval skins, which with probably but little secretion, form the scale of the adult female (Figs. IV. and V.). The female is probably fertilized soon after the second moult, and its body soon becomes swollen with eggs. These are deposited after about the same interval has elapsed as existed between the first and second moults, or between the birth of the larva and the first moult. Thus the life of the female may be divided into three periods, approximately equal in length, and limited respectively by the first and second moult, and the deposition of the eggs. The ova are found under the scale, and the body of the female collapses and dries up, thus making room for them. After a certain interval they give rise to the six-legged larvæ described above.

The Male.

The early stages of the male, the egg, the larva, and the first moult resemble closely the similar stages of the female. The stage following the first moult resembles in outward appearance the corresponding stage in the female; the only difference is that the scale is longer and more oval (Fig. III*b*.).

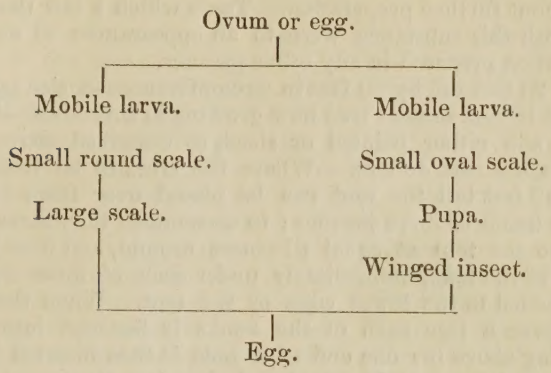
If, however, the insect be examined with a microscope, striking differences can be detected between the two sexes in this stage. Whereas the female remained motionless throughout life, the male ultimately becomes mobile, and already legs, wings, and antennæ are beginning to make their appearance. The stage between the second and third moults is termed the pupa, and the insect in this condition possesses legs and antennæ. The pupa casts its skin, and gives rise to the adult-winged male.

The perfect male (Fig. VI.) is a small insect of a brownish-yellow colour, which possesses a pair of anterior wings of large size. These, when the insect is at rest, lie flat, partly overlapping one another, and are of about the same length as the body. They enable the male to fly readily. The posterior pair of wings are replaced by halteres, which resemble the similar structures amongst the Diptera. The thorax is short and thick, and the abdomen is prolonged into a long process or style, which forms the external organ of reproduction.

During their metamorphosis the males lose their mouth parts, and their place is said to be taken by a pair of supplementary eyes. The adult males are thus incapable of taking food, and their short life is entirely devoted to fertilizing the females.

They are so minute that it is difficult to find them, and the easiest way of procuring them is to rear them from the scales on pieces of orange peel or leaf, which should be enclosed in small boxes with glass lids.

The following scheme represents the life history of this insect :—



Methods of Treatment.

We are in the main indebted to the officers of the division of entomology of the United States Department of Agriculture for the numerous methods which have been devised for dealing with this pest. The most successful of these is undoubtedly the treatment by hydrocyanic gas. The method of applying this, and the apparatus used, requires a detailed account, and I have thought it would be of service to quote the following pages from the report of Mr. D. W. Coquillett,* who has done so much to aid the orange growers of California in their efforts to combat this and other insect pests.

The Gas Treatment for the Red Scale of California.

"Briefly speaking, this process consists in covering the infested tree with an air-tight tent, and afterward charging the tent with hydrocyanic gas. The material commonly used in the construction of the tent is what is known as blue or brown drilling. A few persons have used ducking instead of the drilling, but this is much inferior to the latter; in the ducking the threads of which it is composed extend only lengthwise and crosswise, whereas in the drilling they also extend diagonally—this belonging to the class of goods to which our merchants apply the term "twilled"—and for this reason the drilling is both stronger and closer in texture than the ducking.

"After the tent is sewed up it is given a coat of black paint, as it has been ascertained that tents treated in this manner last longer than those which have been simply oiled with linseed oil. Some persons mix a small quantity of soap suds with the paint in order to render the latter more pliable when dry, and therefore less liable to crack. Instead of thus painting the tent some persons simply give it a coating made of an inferior glue called "size," first dissolving this in water and then covering the tent with it, using a whitewash brush for this purpose. Sometimes a small quantity of whiting or chalk (carbonate of lime, $Ca\ Co_3$), is added to this sizing with or without the addition of lamp-black. A few make use of the mucilaginous juice of the common Cactus (*Opuntia engelmanni*, Salm.) for this purpose; to obtain this the Cactus leaves or stems are cut or broken up into pieces, thrown into a barrel and covered with water, after which they are allowed to soak for

* U. S. Department of Agriculture, Division of Entomology. Bulletin No. 23.

three or four days; the liquid portion is then drawn off, and is ready for use without further preparation. Tents which I saw that had been prepared with this substance were to all appearances as air-tight and pliable as when prepared in any other manner.

"A tent 26 feet tall by 60 feet in circumference—a size large enough to cover the largest orange tree now growing in this State—if made out of drilling, and either painted or sized, as described above, will cost completed about 60 dollars. Where the trees to be treated are not more than 12 feet tall the tent can be placed over them by means of poles in the hands of three persons; to accomplish this, three iron rings are sewed to the tent at equal distances around, and 6 or 7 feet from the bottom of the tent; immediately under each of these rings an iron hook is attached to the lower edge of the tent. When the latter is to be placed over a tree each of the hooks is fastened into the corresponding ring above it; one end of a pole is then inserted into each of these rings, and the tent is raised and placed on the tree. The hooks are then released from the rings and the lower edge of the tent allowed to drop upon the ground.

"Instead of allowing the tent to rest directly on the tree some growers use an umbrella-like arrangement, the handle of which is in two pieces, which are fastened together with clamps provided with pins; this allows the handle to be lengthened or shortened according to the height of the tree. This apparatus is put up over the tree, and the tent allowed to rest upon it. By the use of this simple device the danger of breaking off the small twigs on the upper part of the tree by the weight of the tent is avoided. Mr. Leslie, of Orange, used four tents and tent rests of this kind, and he informs me that with the aid of two men he fumigated 120 trees in one night. To remove the tent from one tree, place it over another, and charge the generator required only one minute and a half. In the place of poles some persons attach a circle of gas pipe to the lower edge of the tent; then two men, each taking hold of opposite sides of this circle threw the tent over the tree. Dr. J. H. Dunn, of Pomona, informs me that four men, using six tents like the above, fumigated 240 orange trees in one night, and that the average for each night was over 200 trees, the latter being 8 feet or less in height. After the tent is placed over the tree the next step is to charge it with the gas. The materials used for the production of the gas consist of commercial sulphuric acid ($K_2 SO_4$), fused potassium cyanide (KCN), and water, the proportions being one fluid ounce of the acid, one ounce by weight of the dry cyanide, and two fluid ounces of water. The generator is placed under the tent at the base of the tree; it consists of a common open earthenware vessel. The water is first placed in the generator, then the acid, and last the cyanide, after which the operator withdraws to the outside of the tent and the bottom of the latter is fastened down by having a few shovelfuls of earth thrown upon it. The tent is allowed to remain over the tree for a period of from 15 to 30 minutes, according to the size of the tree.

"It was found by experimenting that the trees were less liable to be injured by the gas when treated at night than they were when operated upon in day time, and at the same time the gas is just as fatal to the scale insects when applied at night as it would be if applied in the day time; and, indeed, it appears to be even more fatal when applied at night. This is accounted for by reason of the fact that in the day time the light and heat decompose the gas into other gases which, while being more hurtful to the trees, are not so fatal to insects. At night the trees are also more or less in a state of rest, and, therefore, are not so liable to be injured by the gas as they would be in the

day time, when they are actively engaged in absorbing nourishment and replacing wasted tissue with new materials.

"Of the different materials used in generating the gas, the most important is the potassium cyanide; of this there are three grades: the mining cyanide, commercial cyanide, and the C.P. (chemically pure). Of these three brands, the mining cyanide is wholly unsuitable for the production of the gas, and the C.P. is too expensive; the commercial brand (fused) is the only one that is used for producing the gas, but even this varies greatly in strength, containing all the way from 33 to 58 per cent. of pure potassium cyanide. It is, therefore, of the utmost importance that the operator should know the exact per-centage of pure potassium cyanide that his cyanide contains, and when large quantities of it are purchased at one time it would be advisable to obtain one or more analyses of it by a reliable analytical chemist; or if it is not possible to submit the cyanide to such person, an analysis of it could be made by almost any person accustomed to the use of chemicals or drugs.

"The only substance required for this purpose is the crystals of nitrate of silver ($Ag\ NO_3$), which may be obtained at almost any well-stocked drug store. Dissolve the nitrate in cold water contained in a glass or earthen vessel, using one-fourth of an ounce (Troy) of the crystals to one pint of water; this dissolves in a few minutes, forming a whitish, semi-transparent solution. The cyanide, when dissolved in water, forms a transparent, nearly colourless solution; when a small quantity of the nitrate of silver solution is added to this it at first spreads out in a white cloud, like milk, but it soon breaks up into small, white, floccy pieces which gradually disappear upon being agitated, leaving the solution nearly as transparent as at first; when more of the nitrate of silver solution is added from time to time the above process is repeated, except toward the last, when the cyanide solution becomes somewhat milky, but it still remains semi-transparent, permitting the operator to see quite clearly the bottom of the vessel containing the solution. As soon as a sufficient quantity of the nitrate of silver solution has been added to the cyanide solution the latter immediately becomes white and opaque, like milk, completely concealing from view the bottom of the vessel containing it. This completes the operation, and the quantity of nitrate of silver solution used will indicate the strength of the cyanide tested. When absolutely pure, $5\frac{3}{4}$ grains of the potassium cyanide dissolved in water will require one fluid ounce of the above nitrate of silver solution before the turbidity occurs, indicating that the cyanide is 100 per cent. strong; if only one-half of a fluid ounce of the nitrate of silver solution produces this turbidity, this indicates that the cyanide is only half strength, or 50 per cent. strong; if only one-fourth of a fluid ounce is required, then the cyanide is 25 per cent. strong; and so forth. The nitrate of silver solution should be added to the cyanide solution very slowly, the latter being agitated by gently shaking it each time that any of the nitrate solution is added. Wherever any of the nitrate of silver solution comes into contact with the skin or nails of the hand it produces a reddish or black stain, which can easily be removed by washing the stained part in a solution of cyanide and water; this will quickly remove the stain without causing any injury to the parts affected, except, of course, when the stains occur upon a sore or cut in the hand, in which case it would be dangerous to apply the cyanide to these places.

"It sometimes happens that the per-centage of cyanogen (CN or Cy) is given, instead of the per-centage of potassium cyanide (KCN or KCy); but in cases of this kind the per-centage of cyanide can be readily ascer-

tained by always bearing in mind that two-fifths of a given quantity of potassium cyanide is cyanogen. Thus if a certain brand of cyanide contains 24 per cent. of cyanogen, this is equivalent to 60 per cent. of pure potassium cyanide. Potassium cyanide when absolutely pure (equal to 100 per cent.) contains 40 per cent. of cyanogen; and, therefore, no grade of cyanide could contain a larger per-centage of cyanogen than this.

"The potassium cyanide used for producing the hydrocyanic acid gas is principally manufactured by two firms: Power and Weightman, of Philadelphia, Pa., and the Mallinkrodt Chemical Works, of St. Louis, Mo. That made by the first named firm is the most largely used; when purchased by the ton the price is 36 cents per pound for the grade containing about 57 per cent. of pure potassium cyanide, packages and carriage extra. It is put up in tin cans holding 10 pounds each, and also in barrels holding about 400 pounds each. That in the cans is much to be preferred, since the quantity in each is so small that it will soon be used up after the can is opened; whereas, the barrel containing so large a quantity, the cyanide used towards the last will have lost much of its strength by contact with the air. It is customary to weigh out the cyanide in small paper parcels, and mark each parcel with the number of ounces of cyanide that it contains; then when the tree is to be fumigated it is an easy matter for the operator to select one of the parcels containing a sufficient quantity of the cyanide for the tree, thus saving the trouble of weighing out the cyanide as it is to be used for each tree. As the fumigating is done only at night the weighing of the cyanide is frequently done by the ladies of the house upon the day preceding its use.

"The quantity of cyanide to be used on each tree will, of course, depend not only on the size of the tree but also on the strength of the cyanide used. The following table will aid in determining the proper quantity of each ingredient to be used on different sized citrus trees, the cyanide being about 58 per cent. pure:—

Height of Tree.	Diameter of Tree-top.	Water.	Sulphuric Acid.	Potassium Cyanide.
Feet.	Feet.	Fluid ozs.	Fluid ozs.	Ounces.
6	4	$\frac{2}{3}$	$\frac{1}{3}$	$\frac{1}{3}$
8	6	2	1	1
10	8	$4\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{1}{4}$
12	10	8	4	4
12	14	16	8	8
14	10	10	5	5
14	14	19	$9\frac{1}{2}$	$9\frac{1}{2}$
16	12	16	8	8
16	16	29	$14\frac{1}{2}$	$14\frac{1}{2}$
18	14	26	13	13
20	16	36	18	18
22	18	52	26	26
24	20	66	33	33 "

This treatment is not only fatal to *Aspidiotus aurantii*, but also to any other scale insects which may be found on the orange, and to numerous other insects. The gas is of course poisonous to man and other animals, and care should be exercised in using it. At the same time it has been used in a very extensive scale in California, fully 20,000 trees were treated in Orange County alone in 1890; and Mr.

Coquillett states that he has not yet heard of any accident either to human beings or domestic animals resulting from this treatment.

The Spray Treatment.

The gas method of treatment, if properly applied, has a great advantage over any method of spraying, inasmuch as every insect in the tree is killed, whereas it is almost impossible to apply the spray so thoroughly as to leave no insects untouched, and those that escape may form the starting point of a new outbreak. Nevertheless, the gas treatment requires a special apparatus, which may not be at hand, whereas the spray, which has been used with very good effect, is comparatively easily applied. The wash which has proved most useful is the Resin Wash.

(i.) *The Resin Wash.*

The following receipt, given in Insect Life, Vol. II., has proved very efficacious :—

Resin - - -	20 pounds.
Caustic soda 70 per cent. -	6 pounds.
Fish oil - - -	3 pounds.
Water enough to make 100 gallons.	

It is prepared by placing all the ingredients in a kettle and covering them with water. Boil and stir for about two hours, or until the mixture will dilute evenly with water, then add water slowly till the kettle be full. This may then be emptied into a larger receptacle and diluted with water till it amounts to 100 gallons. The water must be added slowly so as not to cool the mixture too suddenly. The resin and caustic soda should be crushed into powder, to facilitate solution. The cost of materials in America amounts to a little under one halfpenny a gallon. An orange tree, 16 feet high and 14 in circumference, was given 14 gallons, which was regarded as an excessive amount, but calculated on this basis the cost amounted to about $5\frac{1}{2}d.$ per tree.

The effect of the wash seems to be due to the suffocating action of the resin and fish oil saponified by the action of the caustic soda, and not to the direct influence of the last-named ingredient.

The wash is usually sprayed over the trees twice a year, in March and April, and again in August or September, but some growers prefer to spray twice in the autumn, with an interval of about two months. The wash does not seem to injure the fruit or leaves. Care must be taken that the scales in the under surface of the leaves do not escape the spray.

If any attempt be made to rid Cyprus of this pest, and it would be obviously an easier task in the case of an island than of any portion of the mainland, it would be necessary to appoint inspectors, whose business it would be to see that proper remedial measures were undertaken in every infected grove. An energetic cultivator who succeeds in freeing his own trees of the pest may fall a victim to the negligence of his neighbours. In cases of this kind it is necessary to take concerted action, as one diseased tree may become the centre from which a whole district may be infected, and to take action of this kind would necessitate some organised system of inspection.

Explanation of Plate.

Fig. I.—A portion of peel from a diseased orange, showing the scales, very slightly magnified.

Fig. II.—Larva of *Aspidiotus ficus* (after Comstock).

Fig. III.—A portion of diseased orange peel, highly magnified.
a. Female, after first moult.
b. Male „ „
c. Female „ second moult adult.

Figs. IV. and V.—Views of adult females, showing the different outline of the scale.

Fig. VI.—Adult, winged male (after Comstock).

CCXIII.—REDISCOVERY OF GUTTA PERCHA TREE AT SINGAPORE.

(*Dichopsis Gutta*, Benth.)

The following account of the continued existence in the island of Singapore of the original species (originally described as *Isonandra Gutta*, Hook.) from which Gutta Percha was first obtained is translated (with some compression) from a note by M. Sérullas in the *Comptes Rendus* for September 15, 1890 (pp. 423–426).

"The existence of Gutta Percha was announced to the civilised world in 1842 by Dr. W. Montgomerie. The priority in this respect of the traveller Tradescant has not been established. In any case the first specimens which reached Europe under the name, coming from Singapore, were brought to London in April 1843 by Sir José d'Almeida.

"In bringing to light their remarkable properties no time was lost by Hancock. Wheatstone, moreover, who had been speculating since 1837 on a telegraphic union between England and the Continent, conceived the idea of employing them for this purpose, but it was not until the 10th of January 1849 that a submarine cable was first sunk by Mr. Walker in the English Channel. This cable, whose length, however, was only two miles starting from Folkestone beach, was sheathed with Gutta Percha.

"Since that time numerous attempts have been made to replace Gutta Percha for this purpose, now that the demand is so great, and it is constantly becoming more scarce and dearer every year. Hitherto they have all failed. The fact is that submarine telegraphy requires gums of the finest quality. Those of *Bassia Parkii* from Africa, and of *Mimusops Balata* from the Guianas, have only given negative results. As for that of *Payena Leevii* (Gutta Sundek), if it is in actual use to-day it is simply owing to mistake on the part of the collectors.

"The only gums which are of use as insulators for cables are produced by trees of the genus *Isonandra* (now sunk in *Dichopsis*). Their natural habitat is exclusively in the Malayan region.

"The destruction of the interesting zone of Malay forests proceeds rapidly. The natives cut every available tree, and repeat the process as fast as they spring up again; they have thus suppressed for the last 40 years their reproduction and multiplication.

"Such gums as those used at the commencement of the industry are no longer met with except in exceptional cases. Those which have replaced them will share the same fate within the next 50 years. Little by little exportations are beginning to cease from the Malay ports. The scanty plantations started in the East Indies are moreover formed not of the better species, but of those which though rich in latex yield an inferior product. Submarine telegraphy, in point of fact, is on the eve of finding itself destitute of those plants which are indispensable to it in the present state of science, yet the source of these guttas is still imperfectly understood.

"Historically the first plant described as a source of Gutta Percha was *Isonandra Gutta*, Hooker. This is the only tree of which the coagulated latex, when sent to Europe, has stood the test of practice. It is described as extinct since 1857 in the island of Singapore, and as existing only in the Malay forests.

"In point of fact this species has become excessively rare, but it is still in existence. Its adult representatives were still propagating themselves in 1887 at Chasseriau estate in the ravines of the ancient forest of Boukett Timah, situated in the centre of Singapore, where it was discovered in 1847 by Mr. Thomas Lobb, who collected on the spot the specimens preserved in the Kew Herbarium. Except Dr. Oxley no one has since succeeded in obtaining it. The tree only flowers when 30 years old, and at intervals of two years. When I found it in 1887 any gutta collecting had ceased for the last 30 years. The extinction of the tree was supposed to be complete. Nevertheless hardly three years ago there still existed in the remnants of the ancient forests of the island adult trees of this species, represented chiefly by offshoots.

"The word 'gutta' in the Malay language is only used in the absolutely general sense of 'gum' or 'glue.' The word 'percha' does not mean merely 'Sumatra' as has hitherto been generally believed (Sumatra is called 'perxa,' which means the inhabited terrestrial world). Percha means 'rag' and exactly characterises the appearance of the gums, which before treatment with warm water resemble rags half reduced to compressed paper-pulp.

"In the Malay forests, in which I travelled for four years, I met with only five kinds of trees which could be mistaken at first sight for *I. Gutta* from their foliage, and from having a similar latex. It is impossible to confuse it with the other species of *Isonandra* which produce gutta of different quality, Gutta Sundek in this respect being intermediate.

"The Gutta Sundek of commerce is evidently a complex mixture."

CCXIV.—NEW PROCESS FOR RECOVERING LOSS OF GUTTA PERCHA.

The following correspondence gives an account of the attempts which have been made, both recently and at a later date, to recover some portion of the Gutta Percha which is left in the bark of the trees after collection by the ordinary native method.

COLONIAL OFFICE to ROYAL GARDENS, KEW.

SIR, Downing Street, August 19, 1891.

I AM directed by Lord Knutsford to enclose, for such observations as you may have to offer, a copy of a Despatch from the Governor of the Straits Settlements on a new process for extracting Gutta Percha.

I am, &c.

The Director of (Signed) R. H. MEADE.
The Royal Gardens, Kew.

The GOVERNOR of the STRAITS SETTLEMENTS to COLONIAL OFFICE.

Government House, Singapore,

MY LORD, July 18, 1891.

I HAVE the honour to inform your Lordship that I witnessed yesterday a process for extracting Gutta Percha from the twigs and leaves of the Gutta Percha tree (*Isonandra Gutta*). It is difficult to over-estimate the importance of the invention, and this will be readily understood when I mention that the method hitherto and still in vogue for obtaining Gutta Percha is to cut down the tree and collect the juice as it exudes from the stem or trunk. This collecting of the juice of the gutta tree is solely in the hands of the natives, who search the jungles for the purpose, and I may add, as a curious detail in their proceedings, that they are reported to consider it necessary to collect the juice from the cut down tree in the dark.

2. Monsieur Eugene Sérullas, a French savant of repute, is the discoverer of the invention to which I refer. I will now describe his process as best I can. The twigs and leaves of the gutta tree, which are obtained by way, as it were, of ordinary pruning, having been brought into the store in bundles are finely chopped up. It is a matter of no moment, apparently, whether the leaves, &c. are still fresh or dead. The chopped up stuff is then treated with acid (which is the main secret of the invention) until a reddish-brown liquor is produced. This is put into an alembic, already supplied with a small quantity of water, to prevent the gutta from sticking to the sides of the vessel, and steam is applied for about twenty minutes or half-an-hour, during which the acid evaporates and is drawn off.

3. In yesterday's experiment, through a desire not to keep me waiting too long, the alembic was opened rather too soon, and the gutta therefore was not properly cooked. But there it was, rather more than one pound of it extracted from thirty pounds' weight of the chopped up leaves and twigs. When the process has been perfected it is expected that the proportion of 2 per cent. at least of pure gutta will be obtained from the raw material.

4. The demand for gutta has increased enormously since the introduction of submarine telegraph cables. It is estimated that the trade consumes 4,000,000 lbs. a year. The article forms one of the principal exports from this Colony, as much as 76,592 pikuls (=10,212,266⅔ lbs.) having been exported last year, the value of which is given at $4,946,890, or about 825,000*l*. The greater portion by far of this quantity goes to the United Kingdom, and has been imported here from Dutch India. From the Protected Native States only a little is

obtained, because, on finding that the forests were being denuded of gutta trees through the destructive system adopted in procuring the sap, a stop was put for a time to its collection.

5. A syndicate has been formed here to work out the process and to establish a factory, and, so far as I can judge, there is every prospect of a very valuable industry and most profitable concern being in their hands.

I have, &c.

The Right Hon. (Signed) Cecil C. Smith.
The Lord Knutsford, G.C.M.G.,
&c. &c. &c.
Colonial Office.

Royal Gardens, Kew, to Colonial Office.

Sir, Royal Gardens, Kew, August 24, 1891.

I have the honour to acknowledge the receipt of your letter of August 19, enclosing a copy of a Despatch from the Governor of the Straits Settlements on a new process for extracting Gutta Percha.

2. It has long been known that both in the case of India Rubber and of Gutta Percha the ordinary methods in use only yielded a portion of the milk contained in the tree or vine operated upon. Where the method of tapping was resorted to this was rather advantageous than otherwise, as the tree was not exhausted by the process, and could at intervals be repeatedly tapped again.

3. Where, however, the tree was felled in order to drain it of its milk, as appears to be the case with Gutta Percha yielding trees, there can be no doubt that the residual loss was very considerable, and the corresponding irrecoverable waste very great.

4. This was carefully pointed out by Mr. Leonard Wray, junior, the Curator of the Perak State Museum, in a very important report presented to Sir Hugh Low, G.C.M.G., then Her Britannic Majesty's Resident, Perak, September 25, 1883. In this he states :—"The bark "on the upper part of the trunk and on the branches . . . is just as "rich in Gutta as the lower portion of the trunk. *Even the leaves* "*contain a notable proportion.*" He estimated that the wet bark contains fully 5·7 per cent. of Gutta Percha, and that "by simply "pounding or rasping and boiling the bark, nearly all the Gutta which "it contained may be extracted." With these facts in view Mr. Wray sent to Kew at the end of 1885 a quantity of the dried bark in order that it might be ascertained whether the residual Gutta could be extracted in this country. The investigation was undertaken, as I informed you in my letter of August 6, 1886, by the India Rubber, Gutta Percha, and Telegraph Works Company, Limited. I may quote the result :—"After a very careful study of the question they find that "though a large proportion of the Gutta Percha is undoubtedly re-"coverable, it is so intermixed with a brittle resin that the resulting "product is commercially valueless."

5. This result is, however, not incompatible with the more favourable results obtained by M. Eugene Sérullas. It is quite possible that by acting upon fresh material the Gutta Percha may be obtained free from deterioration.

6. The idea, however, of obtaining the residual Gutta is not, altogether, a new one. The same problem presented itself in Demerara in the case of Gum Balata. The late Sir William Holmes attempted,

by a method, apparently, purely mechanical, to extract the Balata from the bark by means of a steam crushing mill. The process was, however, I believe, abandoned, the product being too impure for commercial purposes.

7. The method of extracting the Caoutchouc or Gutta Percha by means of a solvent is much more promising if it proves practicable, and yields a product the essential properties of which are not impaired. It is not, however, novel. In 1878, Mr. Sowerby, the Secretary of the Botanical Society of London, appears to have suggested to Mr. Thomas Christy, a plan for growing the African rubber vines "in plantations and cutting down the stems yearly." The stems were then to be crushed and digested with bisulphide of carbon in which the rubber is soluble. The subject was briefly referred to in the Kew Report for 1877 (p. 32). I do not remember meeting with any account of the method being carried out practically.

8. Gutta Percha is a substance which is at present of first-rate importance to civilisation. The trees which yield it are confined to a very limited area on the earth's surface; they are of slow growth, and I believe, at present, no steps are being taken to plant them so as to provide for the Gutta Percha supply of the future. The exhaustion of this important product would seem to be within a measurable distance. The experiments of M. Sérullas, inasmuch as, if successful, they will economise the yield, appear to me to deserve every encouragement.

I am, &c.

(Signed) W. T. Thiselton-Dyer.

The Hon. R. H. Meade, C.B.,
Colonial Office.

A portion of the original report of Mr. Leonard Wray, junior, is reproduced.

Mr. Leonard Wray, Junr. to Sir Hugh Low, K.C.M.G., Her Britannic Majesty's Resident at Perak.

Sir, Taaipeng, Perak, September 25, 1883.

I have the honour to inform you, that in pursuance of the request you made some months ago, I turned my attention to the study of the trees from which the Gutta Percha of commerce is procured, and I now beg to present to you my report, embodying the result of those studies up to the present time, and solicit your special attention to that portion which relates to my discovery of the large quantity of Gutta Percha that may be extracted from the bark which is now entirely wasted.

* * * * * *

Method of collecting the Gutta Taban Merah.

A tree having been found, a staging of saplings tied together with roots or rattens is erected round it, so that it can be cut above the spreading buttresses. The tree is then felled with a little Malay axe, called a "billiong," and as it lies on the ground V shaped rings about one inch broad are cut in the bark, at intervals of 15 to 18 inches, all along the whole length of the trunk and of the large branches, with a heavy chopping knife called a "parang." These cuts soon become filled with the white cream like sap, and in about half an hour the Gutta will have separated from the aqueous portion of the sap, and may then be

removed by rolling a small ball of it round in the cuts, to the edge of which the coagulated gum adheres and forms a disc, varying in size, according to the number of scores it is rolled in.

These discs are then boiled in water, and made into balls, and sold by the collectors to the men who export it to Penang or Singapore.

The Gutta is at first pure white, but soon changes to pink, and finally to a brownish red. The water in which the gum is boiled becomes a dark red brown, and this colouration is the most distinctive feature that this variety of Gutta possesses, and by which it may be easily recognised.

The air seems to have an analogous effect on the sap to that of rennet on milk, coagulating the gummy portions so rapidly, that only a small quantity of their watery stuff runs out of the cuts, all the Gutta Percha remaining as a soft spongy mass in the scores.

The amount of Gutta obtained from a single tree appears to have been greatly over estimated in the accounts that have been written on the subject; and exceptionally large yields from gigantic trees have been erroneously quoted as being an average product, which is clearly by no means the case.

I had a tree felled that was two feet in diameter (at six feet from the ground) and about 100 feet high, the age of which I estimated from its annular rings to be over 100 years. It gave only 2 lbs. 5 ozs. of fairly clean Gutta, valued by a Malay dealer at $1.20 per cattie or 3*s.* 3*d.* per lb., so that the product of this tree was worth only 7*s.* 6*d.*

Some say that if Gutta trees are felled in the height of the rains, and when the sap is rising strongly, they then yield more Gutta than at other times, but I have had no means of testing the truth of this assertion.

* * * * * *

Whilst engaged in collecting specimens and information respecting the Gutta producing trees of Perak, I was greatly struck by the exceedingly small amount yielded by even large trees by the present Malay method of ringing the bark, which led me to an examination of the dried bark, with a view to ascertain, by a series of careful experiments, what proportion of the whole amount of Gutta contained in a tree was actually left in the bark after the usual process of extracting it had been performed. With this object, I had, on the 24th of May 1883, a tree of Gutta Taban Simpor felled, and scores cut in the bark, at distances of 15 inches along the whole length of the trunk, and obtained 12 ozs. of Gutta. Some two or three days after, I had some of the bark removed, and on the 29th I cut some of it up into thin slices across the grain, and boiled them in water for a short time, when I found that Gutta had been expelled, and remained as a slight and irregular coating on the chips. This I picked off, and weighing it I found the yield to be 3½ per cent. of the weight of the wet bark operated. Encouraged by this simple and satisfactory experiment, I next had a weighed sample of bark pounded in a mortar, and then transferred it to a glass vessel, and boiled it in water. In a few minutes the Gutta formed itself into small detached white flakes, and by stirring collected into a mass, which was easily removed from the flask, and purified by re-boiling in clean water. By this method, the sample of wet bark yielded 5·3 per cent. of clean white Gutta. Another weighed sample of bark was cut up and dried in the sun, and then put into chloroform, and after standing some hours, with frequent shakings, the liquid was poured off and allowed to evaporate, fresh chloroform being added to the

bark to extract any Gutta which remained in it. The total product thus obtained was 5·7 per cent. of the weight of wet bark used in the experiment. I next took a weighed sample of wet bark and cut it up into small chips, and dried it thoroughly, and found as the result of several experiments that it lost 50 per cent. of its weight in the process. The following deductions may be made from these results, firstly, that the wet bark which is now allowed to rot in the jungle contains fully 5·7 per cent. of its weight of Gutta Percha, or when dried 11·4 per cent.; and secondly, that by simply pounding or rasping, and boiling the bark, nearly all the Gutta which it contains may be extracted.

After the tree was felled I made careful measurements of it, and weighed portions of the bark, so that I could calculate the total weight on the trunk of the tree up to the first branch, which I found to be 530 lbs. when in the wet state. Now, if we take 5·3 per cent. of this as being the amount of Gutta that may be extracted by the process of pounding and boiling, already specified, we find that it would yield 28 lbs. over and above the 12 ozs. which was obtained by the ordinary Malay method, or to put it in another way, that for every lb. of Gutta collected at present, 37 lbs. are wasted!

In the Kew Report for 1881 I find it stated that in the year 1875 the export of Gutta from the Straits Settlements and Peninsula was estimated at 10 millions of pounds weight. I have no means of ascertaining the accuracy of that estimate, but accepting it as being tolerably correct, we must, from my experiments, come to the conclusion that even if we take the amount of Gutta wasted at only 30 times weight of that collected, there were during that one year no less than 300 millions of lbs., or, putting the price at only 2*s.* 6*d.* per lb., 37,500,000*l.* sterling worth of Gutta Percha thrown away, and utterly lost.

To fully realise the importance of this subject, it must be borne in mind that this vast destruction of these valuable trees (which are of such very slow growth) and of this material, on which the communication of the world may be said in a measure to depend, is going on every year, without any cessation whatever. It will be noticed that I have left out of my calculations all the bark on the upper part of the trunk, and on the branches, which, however, is just as rich in Gutta as the lower portion of the trunk. Even the leaves contain a notable proportion! I have tested also other varieties of these trees, and have obtained almost identical results, therefore I need not enter into further details. The question naturally arises, can the bark be taken from the trees and dealt with in the country, or can it be dried and sent to Europe, to be ground up and treated in the manner I have described, or in some other way sufficiently economical as to be commercially successful? This question deserves the most anxious attention, especially of those who are engaged in the working up of this material, for if it can be successfully accomplished, then the same supply could be furnished with one thirtieth of the present annual destruction of trees!

With the object of having this point so far tested, I have collected some bark, and am sending it to the Royal Gardens at Kew, with a request to have it sent to one of the large manufacturers, so that a report may be obtained from them on the subject. The labour involved in stripping the trees, carrying out the wet bark from the jungles (where no roads nor even paths exist), drying it, carrying it to a port and thence to England, are items of expense which must not be overlooked! At the same time, it must also be remembered that some other jungle products, quite as bulky, and not so valuable, are yet exported with profit.

If the Gutta contained in the bark can be profitably extracted, the planting of those trees on waste lands might possibly be undertaken by Government, with every prospect of success. The variety that seems to be most easily grown is *Payena Leerii* (Gutta Sundeh). This tree fruits freely, and will thrive on the swampy plains near the coast, and is said by the Malays to grow fast. Its wood is hard, with a close grain, and takes a good polish, therefore may be of some value as timber. I have tried experiments in making cuttings of some species of *Dichopsis*, but have not had any success as yet, although it is probable that they may be propagated by this means, when the proper mode of effecting it is found out. I have not tried *Payena Leerii* as yet, but hope to be able to do so very shortly.

I have, &c.
(Signed) L. Wray, Junr.

The following correspondence gives the results obtained from the material sent home by Mr. Wray :—

The India Rubber, Gutta Percha, and Telegraph Works Company, Limited, to Royal Gardens, Kew.

106, Cannon Street, London, E.C.,
Sir, August 5, 1886.

Referring to your letter of the 11th June, which was acknowledged on the 16th of the same month, I beg to send you enclosed a report from our analytical chemist on experiments carried out by him with the Gutta Percha bark which you forwarded to us. You will notice that we obtained 13·6 per cent. of gutta and resin, which agrees fairly well with the analysis of Mr. Wray, who gives the proportion as 11·4 per cent.

There is no doubt that there is a considerable quantity of resin in the sample which I enclose. The presence of this resin diminishes the commercial value of the gum to such an extent that there is, so far as we see, no profitable outlet for it. I would also draw your attention to the chemist's report where he says : " It is very improbable whether " its recovery by means of solvents would be remunerative, as the " necessary loss in treating such large quantities of accompanying " useless matter would be very great." Our decision is therefore that the material is practically useless.

Regretting we cannot give a more favourable report.

Yours, &c.
(Signed) Robert Kaye Gray,
Engineer in Chief.

W. T. Thiselton-Dyer, Esq., C.M.G., F.R.S.,
Royal Gardens, Kew.

[Enclosure.]

Mr. Thos. T. P. Bruce Warren, Analytical Chemist, to the India Rubber, Gutta Percha, and Telegraph Works Company, Limited.

Dear Sir, Silvertown, E., August 4, 1886.

We have examined the bark of a tree referred to in letter from W. T. Thiselton-Dyer, Esq., dated June 11th.

Our examination has been principally directed to the following points, viz., whether the extraction of Gutta Percha from the same could be made remunerative as a commercial venture, and whether there is any probability of its meeting with a specific application which may give it a commercial status.

As a source of Gutta Percha many points have to be considered, apart from the quality of the Gutta Percha which may be obtained from it.

The most apppropriate method for extracting the Gutta Percha from it, is in treating the crushed bark with a suitable solvent of a volatile nature, so that the recovery of the soluble matter may be attended with little chance of alteration in his physical properties.

The crushed bark thus treated yields 13·6 per cent. to bisulphide of carbon. On evaporating the solvent a residue is obtained, which hardens on cooling, and softens in warm water; in fact, in these respects it strongly comports itself to Gutta Percha; in colour and tenacity it is unlike any description of ordinary good Gutta Percha.

It is very improbable whether its recovery by means of solvents would be remunerative, as the necessary loss in treating such large quantities of accompanyirg useless matter would be very great.

The want of tenacity in the product obtained is due to the presence of a brittle resin, which also contributes to the facility of softening at a low temperature. The difficulty of manipulating the same by any ordinary appliance used in treating Gutta Percha or India Rubber, adds to the difficulty of suggesting a probable field in which its properties would be appreciated.

I am, &c.

(Signed) Thos. T. P. Bruce Warren.

Robert Kaye Gray, Esq.,
106, Cannon Street, E.C.

Royal Gardens, Kew, to Colonial Office.

Sir, Royal Gardens, Kew, August 6, 1886.

I have the honour to inform you that Mr. Leonard Wray, junior, Curator of the Perak Museum, addressed September 25, 1883, a very valuable report to Sir Hugh Low, K.C.M.G., Resident in that State, upon the Gutta Percha yielding trees indigenous to it.

In this report he set out grounds for believing that no less than 30 times the amount of Gutta Percha actually extracted by the process of felling remained in the tree and was thereby wasted.

Struck with this fact he was anxious to ascertain if any part of this enormous residue could be extracted from the dried bark after removal from the tree.

As will be seen from the accompanying correspondence four barrels of bark of one of the species were despatched to Kew for the purpose of obtaining a report upon the question.

The India Rubber, Gutta Percha, and Telegraph Works Company, Limited, as in so many other cases, obligingly assisted this establishment in the matter.

I regret to say that after a very careful study of the question they find that though a large proportion of the Gutta Percha is undoubtedly recoverable, it is so intermixed with a brittle resin that the resulting product is commercially valueless.

Unfortunate as is this result it by no means diminishes the credit due to Mr. Wray for his thoughtful suggestion.

As the question involved is one of the greatest interest, I venture to hope that you will think it advisable to communicate copies of the correspondence to the Government of the Straits Settlements, by whom they will, no doubt, in turn, be transmitted to Sir Hugh Low.

I am, &c.

(Signed) W. T. Thiselton-Dyer.

The Hon. R. H. Meade, C.B.,
Colonial Office, Downing Street, S.W.

Colonial Office to Royal Gardens, Kew.

Sir, Downing Street, August 17, 1886.

I am directed by the Secretary of State for the Colonies to acknowledge the receipt of your interesting letter of the 7th inst. respecting the Gutta Percha yielding trees of Perak, and to inform you that a copy of it has been sent to the Governor of the Straits Settlements.

I am, &c.

(Signed) Robert G. W. Herbert.

The Director, Royal Gardens, Kew.

CCXV.—TAGASASTE.

(*Cytisus proliferus*, Linn.)

The following account of this useful fodder plant is reproduced from the Kew Report for 1879, p. 18.

We are indebted to Dr. G. V. Perez for seed of this forage plant (*Cytisus proliferus*, var.). It is a shrub indigenous to the Canaries, the leafy branches of which are said to be a useful fodder. It requires a light dry soil, and is rather intolerant of frost in winter. The plants should be placed six to ten feet apart, may be cut two or three times a year, and will last 10 to 20 years. Thirty-five pounds of fresh chopped Tagasaste, mixed with 20 lbs. of chopped straw, is said to be sufficient for the daily nourishment of a horse or cow. The seed is very slow in germinating. It was pretty widely distributed from Kew.

Circular from Royal Gardens, Kew, to Colonial Governments.

Royal Gardens, Kew,

Sir, July 18, 1879.

I am sending you, through the Colonial Office, a packet of seed of Tagasaste (*Cytisus proliferus*, var.). This is a shrub, a native of the Canaries, the leafy branches of which are said to be a useful fodder. It requires a light, dry soil, and is rather intolerant of frost in winter. The plants should be placed six to ten feet apart, may be cut two or three times a year, and will last 10 to 20 years. The seeds are very slow in germinating.

I am, &c.

(Signed) W. T. Thiselton-Dyer.

1879. Extracts from Kew Report.

Madras.—Most of the seedlings died off after germination. Colonel Grant reports at commencement of present year :—"At present only "two or three are looking healthy, and from them I should think very "little fodder would ever be obtained."

South Australia.—Dr. Schomburgk reports from Adelaide :—"The "seeds were sown and all came up. The growth of the plant is "vigorous, some of the plants having reached two to three feet, "looking healthy, not in the slightest degree affected by the severe dry "weather we have had to contend with. I have many plants for "distribution."

The Administrator of the Transvaal to Royal Gardens, Kew.

Government House, Pretoria, Transvaal,
Sir, September 7, 1879.

I have the honour to acknowledge and thank you for your letter of July 18th, together with the accompanying packet of seeds (Cytisus proliferus, var.) which arrived safely.

The seeds have been distributed in various districts of the Colony for the present sowing season, and I shall have much pleasure in communicating to you at a future date the particulars of their growth and progress.

I have, &c.
W. T. Thiselton-Dyer, Esq., (Signed) W. Owen Lanyon,
Royal Gardens, Kew. Administrator.

1880. Extracts from Kew Report.

Adelaide.—Dr. Schomburgk reports :—"The seeds have grown "uncommonly well, the plants reaching a height of four to five feet. "There is not the slightest doubt that this plant delights not alone "in our climate, but in any kind of soil and situation . . . . . I "do not doubt a moment that this shrub if sown on the sheep runs, "naturally well covered with soil, will soon become acclimatised, and "will stock the runs with a new fodder plant."

Brisbane.—In these gardens the seed germinates freely in the open air, but makes but little progress in its subsequent growth.

1881. Extracts from Kew Report.

Ootacamund.—Mr. A. Jamieson, Superintendent of the Botanical Garden, reports, July 7, 1881 :—"Nothing could be more satisfactory "than the growth this plant has made during the past year. Several "dozens of plants put out in a bed of stiff, rather poor soil, have "made a wonderfully rapid growth, many of them being 15 feet "in height, and are well furnished with branches, which are covered "with succulent healthy foliage. I have tried milch cattle, sheep, "goats, &c. with it; sheep and goats eat it greedily; cattle eat "it, but do not seem to care for it much. I have no doubt, how-"ever, if they were persistently tried with it they would partake of "it freely. The plant is perfectly hardy, and is not affected by frost

" or drought, and I feel certain would thrive in many parts of these " hills, where nothing else of any value as a fodder would succeed. " The plants are coming into flower, and will probably yield a quantity " of seed by the autumn."

1882. Extract from Kew Report.

Adelaide.—Dr. Schomburgk reports :—" I must again especially " recommend to the squatter the 'Tagasaste,' which has found a most " genial climate in South Australia. The dry season has not shown " the slightest effect on the plants. If the seed be sown on the runs it " would soon become acclimatized, and would stock them with a profit- " able shrub capable of withstanding the severest drought. Although " I offered seed of the 'Tagasaste' for distribution, only a few appli- " cations have been made in South Australia, but a large number were " received from the neighbouring colonies."

In 1886 the merits of Tagasaste were again brought into notice through the Foreign Office.

British Consulate, Teneriffe, to Foreign Office.

My Lord, Teneriffe, September 1, 1886.

Dr. Victor Perez, a Spanish gentleman residing in this island, who devotes much of his time to agricultural pursuits, mentioning to me the suitability and nutritive qualities of a certain kind of grass, the " *Cytisus proliferus*, varietas," and highly recommending it as an all the year round food for horses and cattle, I obtained from him a sample (forwarded separately in a canvas bag) and descriptions herewith enclosed of the grass or hay, which, in the interest of the trade in England, and in pursuance of the Foreign Office Circular of 31st July last, I beg leave to submit to your Lordship as a commercial item for the information of Chambers of Commerce and others interested in such matters.

I have, &c.

Her Britannic Majesty's Secretary of State, Foreign Affairs, Foreign Office, London. (Signed) J. Hutton Dupuis,

Description of the Tagasaste by Dr. Victor Perez.

A shrub, a native of the Island of Palma, the precise site where it grew originally being on the hills above the celebrated Chapel of *Our Lady de las Nieves*, at a height of one thousand *metres* above the sea level.

Taken from there to other parts of that island by native farmers, it soon obtained great repute for feeding cattle.

Introduced into Teneriffe by Dr. Victor Perez he made known its properties in a pamphlet published in 1865, " Apuntaciones sobre el Tagasaste por el Dr. Victor Perez, Santa Cruz de Tenerife, 1865."

Since then Dr. Perez has made a special study of this plant, and has published in 1867 and 1879 the results of his observations.

At present its suitability as green food for cattle is undoubted, and it is certainly superior to any other known. During the last two years

Dr. Perez has made fermented hay after the German style (*see* sample sent).

Fermentation produces a sweet principle which makes it particularly palatable to horses and ruminants, so that during the rainy or winter season, in which there are no other plants for food, the Tagasaste should be stored as hay, the more so, as it can be cut several times during the year, and that during the summer it is perhaps more luxuriant than ever.

Sheep taken from the pastures to Santa Cruz awaiting shipment, and there submitted exclusively to Tagasaste hay as food, gained in weight; the quantity of hay allotted to each was 2 lbs.

Horses do remarkably well with it alone; they also take it mixed with chaffed straw.

Its cultivation deserves of every attention being paid to it, and once its nutritive properties being made known by analysis and experience, it may become an article for exportation and a great resource for farmers in Teneriffe and the other islands where they know not what to cultivate at present with profit.

Dr. Perez has sent some seeds to Kew and to Paris. It could grow well at the Cape of Good Hope, and at Algiers, and in other countries whose climate resembles that of the Canaries.

Its great value is manifest from the fact that it requires no irrigation, that it can grow in comparative barren land up to a height of about 4,000 feet, and above all, that its branches can be cut off *three* times during the year, resisting perfectly well a long dry summer. It lives a great many years and produces from the second or third.

1888. Dr. Schomburgk reports from Adelaide:—

* * * * * *

The Tagasaste has found a most suitable and congenial climate in South Australia, flourishing alike in wet and dry seasons. I have frequently called attention to the value of this plant in my reports of previous years, and during that time have distributed seeds for cultivation. It seems to me that in matters of this kind, both the pastorists and agriculturists have hitherto shown a most remarkable degree of apathy. The Tagasaste requires but little trouble in cultivation; it readily adapts itself to the climate, and with a small amount of exertion would soon stock any run into which it might be introduced with a profitable fodder shrub. I am glad to say that, recently, applications from farmers for seed are on the increase. For the benefit of those who are inclined to profit by the experience afforded by the late drought, I once more recapitulate the valuable qualities of the Tagasaste as well as the mode of treating it.

The seed may be sown broadcast in the usual way, but, before sowing, it is well to soak it for a few hours in hot water so as to soften it, and allow it to germinate the more freely. When the plants come up too freely they should be thinned out, and those which are removed may be planted out elsewhere. They should stand 8 feet or 10 feet apart. For the first two years the shrub does not attain its fullest development. In the third year a large foliage is obtained, which becomes permanent. After the third year the plants should be cut from 2 feet to 3 feet from the ground, so that they may become bushy. They may be cut twice or thrice a year, according to their growth.

Tagasaste has the advantage of containing a large quantity of nitrogenous matter. It is estimated to contain 1·136 of nitrogen

against 1·028 in an equal quantity of first class clover hay. Each 100 lbs. of Tragasaste fodder is calculated to produce 2·60 lbs. of flesh. Animals fed upon it come into condition more rapidly and in a greater degree than with any other sort of food, except corn.

It is said that animals in Madeira fed on Tagasaste so mixed, fatten more rapidly than with any other fodder, or than with hay. This is thought to be due to the presence in the plant of an essential oil, which retards the waste of tissue, and so promotes fattening. The very favourable accounts which are given of this plant are such as ought to induce farmers to try it. Considering that the most severe drought does not affect it at all, it would be advisable for every farmer to plant every spare corner of his land with Tagasaste.

1889. W. Hutchins, Conservator of Forests, writes in the Journal of the Cape Department of Agriculture :—

Tagasaste is sown in 8 or 10 of the forest nurseries in the forest country north of King William's Town. The seed was obtained partly in the colony and partly from Paris. Both samples of seed germinated equally well. A good deal of it was eaten down by insects during the stormy weather of the summer rains, and it does not appear to be hardy against either frost, drought, or the weeds of the country, but when kept in the nurseries and cared for it grew well. I am informed that its progress since I left that part of the Colony is good.

Extracts from Report of Adelaide Botanic Garden (p. 6).

Dr. Schomburgk* writes :—I feel it desirable once more to direct attention to the Tagasaste. It seems that its value as a fodder plant is fully recognised in the neighbouring colonies. In a letter from Mr. G. Kuch, from Gippsland, to whom I forwarded some of the seed, that gentleman writes as follows :—"It is now four years since I sowed "the seed of the Tagasaste, and the shrubs have reached a height of "from 13 feet to 14 feet. The branches have been clipped several times "during the summer months. The clippings are eaten with great "avidity by cattle and sheep. After clipping, the branches soon start "growing again. The shrub appears to thrive better in sandy soil, and "to grow more vigorously than in heavy ground. It possesses another "property, which will be of immense value to apiarists in places where "it is cultivated : it flowers from May to September ; during this "period, when flowers are very scarce, its blossoms are plentiful, and "the shrub is frequented by swarms of bees. I consider it to be one of "the most valuable trees ever introduced into Australia." No doubt Tagasaste is most valuable to those engaged in bee-culture. Indeed, I can confirm Mr. Kuch's statement in this respect, for the trees that are in the Botanic Garden are covered with bees during the flowering season.

Mr. Frederick Turner, Botanist to the Department of Agriculture, New South Wales, reports adversely :—

A Canary Island shrub called Tagasaste is now occupying much attention in some quarters, which experience will eventually prove to

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* It is with great regret that the death must now be recorded of the accomplished Director of the Botanic Gardens, Adelaide, on the 24th March 1891, aged 80.

have been misdirected. I have observed this shrub for a number of years, having raised from seed some of the first plants ever seen in Australia. I have a shrub now under my charge which is about 15 feet high, but I can firmly assert that an old man salt bush (*Rhagodia parabolica*) would at the same age have produced about twice the amount of a superior fodder, and would grow in even more adverse circumstances of drought and heat.

Extract from the Report of the Durban Botanic Society.

In my report for 1889 I gave some particulars about this plant, and by the kindness of Messrs. Miller & Co., of Las Palmas, I obtained a bag of seed for distribution. This was divided into packets, each containing enough to plant about half an acre of ground, and of these packets 72 have been sent out free to applicants, chiefly in the midland and upland districts, including five to Transvaal. It succeeds well in all parts of Natal. A correspondent in Madeira, where the plant has been lately introduced, says:—"It is now thriving well with us, and "sheep are simply mad for it. It thrives in the summer heat without "watering, and I am obliged to keep the sheep off it until it gets high "enough to be out of their reach so as to give it breathing space. The "cattle like it, and when overgrown it gives firewood, green manure, "&c. Its light shade encourages the grasses in dry weather. I "consider it one of the best fodder and all round plants that have ever "been introduced here."

CCXVI.—KANGRA BUCKWHEAT.

(*Fagopyrum tataricum*, var.)

In January 1890 there was received at Kew a packet of seed of a particular kind of Indian Buckwheat which differed in some respects from the ordinary sorts of *Fagopyrum tataricum*, Gærtn. Mr. J. F. Duthie, F.L.S., Director of the Botanical Department of Northern India, from whom the packet was received, was good enough to supply some interesting particulars respecting the origin and characteristics of this buckwheat. The ordinary buckwheat (*Fagopyrum esculentum*, Mœnch.) is extensively cultivated on the Himálaya, where it forms a rainy season crop, being sown in July and reaped in October. The buckwheat of the higher Himálaya appears to be *Fagopyrum tataricum*, Gærtn. The Kángra Buckwheat is a variety of this latter species.

Director of the Botanical Department, Northern India, to Royal Gardens, Kew.

Camp, Chanda District,
Central Provinces, India,
December 19, 1889.

My dear Dyer,

I am sending you a packet of a particular kind of Buckwheat, *Fagopyrum tataricum* (var. nov. according to Regel). A sample of this kind was sent from Saharunpore to St. Petersburg in 1878, along with numerous other seeds and vegetable products which were collected

on the occasion of the Paris Exhibition. Professor Batalin, of the Imperial Botanic Garden, wrote to me some months ago asking me to send him a large quantity of this buckwheat for trial cultivation in Russia, observing that this particular variety was not known in Europe, and that the core being light and loose it was suitable for the preparation of groats. As no record was kept as to the locality from which the original sample was obtained, I had some difficulty in getting hold of it, but at last received a sample from a place on the Punjab Himalaya above Kángra. As the seed is quite fresh I think perhaps you may wish to sow some at Kew, and retain a portion of it for the Museum.

Yours, &c.

J. F. Duthie.

CCXVII.—MISCELLANEOUS NOTES.

The Secretary of State for the Colonies has appointed, upon the nomination of Kew, Mr. C. A. Barber, B.A., late scholar of Christ's College, Cambridge, and University Demonstrator in Botany, to be Superintendent of the Botanical and Agricultural Department in the Leeward Islands.

The Secretary of State for India in Council has appointed, on the nomination of Kew, Mr. A. B. Westland, late Assistant to the Superintendent of the Botanical and Afforestation Department, Hong Kong, to be Superintendent of the Taj Gardens at Agra, N.W. Provinces, India.

The Secretary of State for the Colonies has appointed, on the nomination of Kew, Mr. W. J. Tutcher, Sub-foreman in the Royal Gardens, to succeed Mr. Westland as Assistant to the Superintendent of the Botanical and Afforestation Department, Hong Kong.

Dr. N. L. Britton, of Columbia College, New York, has presented to the Herbarium of the Royal Gardens a further batch of about 450 species of western South American plants which he is publishing from time to time in the "Bulletin" of the Torrey Club.

The Herbarium formed by a Moravian missionary named Bernhard Schmid, in the Nilgiris, about the middle of the first half of the present century, has been acquired by exchange from Dr. Stahl of Jena. It is valuable for the types it contains of two decades of plants published by Zenker, 1835–1837.

Mr. G. H. Garrett, a travelling Commissioner, has presented a small but interesting collection of economic plants from Sierra Leone, with notes on their uses and habitats.

Captain J. Donnell Smith of Baltimore has presented a set of the plants collected by himself last year in Guatemala. As in previous

collections, the specimens are in excellent condition, and they represent about 670 species.

A large collection of Malayan plants has been received from Dr. King of Calcutta. They are mostly new species described by him in his "Contributions to the Botany of the Malayan Peninsula."

The Hon. D. F. A. Hervey, Resident Councillor, Malacca, has presented a collection of about 500 species made by himself in Malacca.

Among Cryptogams the most important additions to the Herbarium are a set of *Nostochineæ*, from Prof. C. Flahault, and various Australian Fungi from Sir Ferdinand Mueller, K.C.M.G. Professor Flahault's gift is valuable in connexion with his recent monograph.